REMARKS

In the Office Action dated April 6, 2004, claims 1-20 are pending. Claims 1, 9, and 19 are independent claims from which the remaining claims 2-8, 10-18, and 20 depend therefrom.

The drawings stand objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include reference signs mentioned in the description of the application. The Office Action states that an attached drawing correction page was not submitted with the previous response. As a result, the drawing correction page is submitted herewith. The submitted page has been corrected to include numerical designators 16, 54, and 56. Please substitute the one sheet of drawings submitted herewith containing Figures 1 and 2 in place of the originally filed drawing sheet containing the same figures. The Applicants submit that the drawings are now in a condition for approval.

Claims 1-20 stand rejected under 35 U.S.C. 112, second paragraph as indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Office Action states that the scope of applicant's claims is vague because applicant fails to define in the specification the components, which constitute the "rigid body motion generator", the specific "magnetic stiffness and damping signal" generated by the eddy current analyzer, the mechanical model generator, the structural analyzer, and the field instability calculator.

The Applicants, respectfully, submit that Figure 2 shows a block diagrammatic view of a magnetic resonance imaging field instability simulator, which is stated in the Brief Description of the Drawings and in the Detailed Description sections of the specification. The simulator does not refer to an MRI system for the scanning and imaging of a patient, but rather refers to a system for simulating conditions, operations, or phenomena that occur during the operation of an MRI system.

Paragraph [0031] of the specification states that the simulator 80 includes a rigid motion body generator 82, an eddy current analyzer 84, a mechanical model generator 86, a structural analyzer 88, a field instability calculator 90, and an image generator 92 and briefly describes the functions thereof. Paragraphs [0033]-[0040] describe in greater detail the functions of each of the components 82-92. Paragraph [0032] of the specification states that the simulator 80, which includes the above-stated items or components, may be microprocessor based, such as a computer. The components 82-92 may be software or hardware based and may be part of a single controller or may be separate stand-alone components. Thus, the components may be in the form of software modules or may each be separate hardware components, which simulate certain characteristics of an MRI system, but are not actually part of or form an actual MRI system. As an example, the components 82-92 may be software modules contained within a computer system. Thus, paragraphs [0031] and [0032] alone provide a clear and unambiguous description of the above stated components.

In regards to the magnetic stiffness and damping signal, the magnetic stiffness and damping signal is generated by the eddy current analyzer 84, as stated in paragraph [0035], and corresponds to the magnetic resistance force due to eddy current. The magnetic stiffness and damping signal, as denoted, is a signal not a component that is generated by the eddy current analyzer 84 and further utilized by the mechanical model generator 86.

The Office Action states that Figure 2 is ambiguous and that the Examiner cannot ascertain from applicant's specification or figures if the components listed in box 80 are actual separate components, or simply a series of method steps. Paragraph [0031] of the specification states that the simulator 80 simulates a MRI system component. Paragraph [0032] of the specification states that the simulator components 82-92 may be software or hardware based. Clearly, the box items 82-92 are components and are shown as such. The names of each of the components are shown in boxes 82-92 and include terms, such as "generator", "analyzer", and "calculator", which are terms typically used to describe components. The names

denote components and are as such in the form of nouns. In boxes 82-92 there are no action terms or terms that are in the form of a verb, which are often utilized or seen in method steps. For example, in the method of Figure 3 the terms "generate", "perform", and "modify" are used to describe a certain action or task that is being performed in the associated method step. Thus, Applicants submit that Figure 2 is clear and that one can easily ascertain from any of paragraph [0016], paragraphs [0030]-[0040], or Figure 2, that boxes 82-92 are components not method steps, which may be part of a single component or may each be stand-alone components.

The Office Action states that the Examiner interpreted Figure 2 to be actual components similar to Figure 1 in the First Office Action, but that Applicants have argued that the claimed simulator is not an actual MRI system. Applicants submit that boxes 82-92 are components and that the claimed simulator is not an actual MRI system. It appears that the Examiner is interpreting the term "component" to be an actual hardware device that performs a physical function rather than a device that simulates that function. Applicants submit that the term "component" may refer to any item that is hardware or software based. A component may perform a physical function or simulate the performance and results of that function. The term "component" is defined as a constituent part of a whole, Webster's Third New International Dictionary. In other words, a component as applied to the present application is merely part of a device, module, or system. A component may be an MRI system or may be part of a simulator, as in the present application.

Thus, Applicants submit that claims 1-20 do particularly point out and distinctly claim the subject matter which applicant regards as the invention. Therefore, claims 1-20 are in a condition for allowance at least with respect to 35 U.S.C. 112.

The Office Action states that the Applicants should clarify whether <u>components</u> 80-90 are part of an overall computer system and whether they are part of the same physical computer component and are method steps or separate components. As stated above, components 80-90 are components, are not method steps, may be part of a computer system, and may be part of the same physical

computer component or may be separate components. In a simple configuration, the components 80-92 may be software modules contained within a single computer system. However, in a more complex configuration, the components 80-92 may be separate hardware components that provide desired signals, which simulate the actual performance of MRI system components.

The Office Action further states that the claims fail to require "simulated" components in each of the limitations of the independent claims and that Applicants invention is for an MRI simulator only. Independent claims 1, 9, and 19 recite an MRI magnet field instability simulator and methods of simulating and determining field instability within an MRI system. The first limitation of each of claims 1, 9, and 19 recites the simulating of motions of one or more MRI system components. The term "motions" refers to an act, process, or instance of changing place, Webster's Third New International Dictionary. Each and every limitation thereafter recited in claims 1, 9, and 19 performs a function or task in response to those simulated motions. Thus, the result of the tasks performed by the limitations of claims 1, 9, and 19 is derived from the simulation of MRI system component motions. Applicants submit that claims 1, 9, and 19 do clarify that they are directed to an MRI simulator and MRI simulation methods and not to an actual MRI system and since all of the limitations of claims 1, 9, and 19 are performed in response to simulated component motions, the recitation of the term "simulated" in each limitation is not necessary or appropriate. For example, the structural analyzer 88 does not simulate the generation of a motion signal, but rather actually generates a motion signal.

The Office Action states the Kinanen (USPN 6,433,550 B1) is considered prior art due to the 35 U.S.C. 112 rejections and that Kinanen does not provide an MRI simulator. Applicants submit that since the 35 U.S.C. 112 rejections are now overcome and since it is agreed that the system disclosed in Kinanen is not an MRI simulator, but rather an actual MRI system that Kinanen is no longer a valid reference. Note that Kinanen also does not provide method steps for the simulation of MRI system components.

Claims 1-17 and 19 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kanayama et al. (USPN 5,519,320).

Claims 1, 9, and 19 are similar and are therefore discussed together. Claims 1, 9, and 19 recite an MRI magnet field instability simulator and methods of simulating and determining field instability within an MRI system. Each of claims 1, 9, and 19 include the limitations of: simulating motions of one or more MRI system components; generating a magnetic stiffness and damping signal and an electromagnetic transfer function in response to the motions and a cryostat material properties signal; generating a mechanical disturbance signal and a mechanical model of one or more MRI system components in response to the motions and the magnetic stiffness and damping signal; generating a motion signal in response to the mechanical model; and generating a field instability signal in response to the electromagnetic transfer function and the motion signal. Applicants submit that none of these limitations are taught or suggested by Kanayama.

Kanayama discloses an actual MRI system or MRI apparatus. The MRI apparatus includes a sequence controller 9 for controlling the operations of a main magnet power source, a gradient coil power source, a transmitter unit, a receiver unit, a data acquisition unit, a data processing unit, a display unit, a console, and a host computer. In Kanayama a pulse sequence form and type are selected and an appropriate pulse sequence is transmitted to the sequence controller. The sequence controller adjusts the pulse sequence in response to existing characteristics of the MRI system and of the patient. The sequence controller adjusts the pulse sequence to allow for the speeding up of operations related to the decoding of event codes and the rewriting of event memory in order to take advantage of instantaneous or real time imaging.

In adjusting the pulse sequence, the sequence controller simulates the pulse sequence using a simulated RF pulse waveform, a simulated gradient magnetic field waveform, a simulated static magnetic field, and a simulated nuclear spin density distribution, and according to the existing system and patient characteristics. The pulse sequence is adjusted using parameters and signals determined from equations

used for such sequence simulation. Note that in performing the stated pulse sequence simulation the sequence controller of Kanayama is simulating a pulse sequence and is not simulating the motion of any of the components of the MRI apparatus.

The Office Action states that Kanayama teaches and suggests a magnet field instability simulator and refers to Figure 11, component 24 and description sections thereof for such teaching. Applicants submit that component 24 simulates a pulse sequence, but does not simulate instabilities within an MRI system generated from the motions of MRI system components. Component 24 of Kanayama is a simulator component of the sequence controller 9 and performs the tasks associated with the simulation of a pulse sequence. Component 24 is not used to simulate the motions of a component, but is rather used to simulate the affects of RF pulses on a magnetic field to ascertain the slice and field characteristics as a result therefrom.

The Office Action states that Kanayama teach and suggests components "comprising: a rigid body motion generator simulating motions of one or more MRI system components" and refers to the sequence controller 9, col. 6, lines 32-42; and col. 9, line 57 through col. 10, line 68. Applicants submit that nowhere in Kanayama are the motions, movements, or changing place of any component or rigid body mentioned and as a result Kanayama does not teach or suggest the simulation of such motions. In col. 6, lines 32-42, Kanayama discloses, as stated above, the simulation of a pulse sequence not a simulation of an MRI system component. In col. 9, line 57 through col. 10, line 68, Kanayama discloses the steps carried out in providing the simulation of the pulse sequence. Kanayama discloses the simulation of field motion, of a magnetic field, and of RF pulses and the results generated therefrom, such as the echo signal S(t).

The Office Action states that Kanayama teaches and shows the presence of "an eddy current compensation analyzer" and refers to component 48 for such reliance. Applicants submit that component 48 of Kanayama is an eddy current compensation unit, which is part of a gradient coil power source. The compensation unit is used to adjust the power supplied to the gradient coil to compensate for

generated eddy current within the MRI apparatus. The compensation unit of Kanayama is not an analyzer. In other words, the compensation unit does not analyze incoming signals to generate output signals, but rather simply adjusts the power supplied to a gradient coil as a result of the eddy current measured. The compensation unit does not generate a magnetic stiffness and damping signal and an electromagnetic transfer function in response to MRI system component motions and a cryostat material properties signal, as does the eddy current analyzer of claim 1 and the methods of claims 9 and 19.

It is admitted in the Office Action that Kanayama does not directly teach the generation of a magnetic stiffness and damping signal. Applicants agree. Applicants also submit that Kanayama does not teach or suggest the generation of a magnetic stiffness and damping signal in response to the simulation of MRI system component motions, since component motions are not even monitored or simulated. The altering of a gradient magnetic field in response to the measured or generated eddy current is clearly not the same as the generation of a magnetic stiffness and damping signal in response to the simulation of MRI system component motions. In compensating for eddy current one is providing a desired gradient field within an MRI system. In generating a magnetic stiffness and damping signal in response to the simulation of MRI system component motions one is generating a representation of the magnetic resistance force due to eddy current of material contained within the MRI system component of concern.

In addition, Kanayama does not teach or suggest the generation of an electromagnetic transfer function in response to the simulation of MRI system component motions. The electromagnetic transient response of Figure 7b of Kanayama, referred to by the Office Action is not the same as the electromagnetic transfer function of claims 1, 9, and 19. The electromagnetic transient response of Kanayama is used to determine the transient response of the gradient magnetic field. The electromagnetic transfer function of claims 1, 9, and 19 is a result of eddy current analysis and relates field disturbance and component or unit motion.

Furthermore, Kanayama does not teach or suggest the generation or use of a cryostat material properties signal. The Office Action states that Kanayama lacks directly teaching a cryostat material properties signal. Applicants agree. However, the Office action states that simulating nuclear spin density distribution is taught. Applicants submit that nuclear spin density of a magnetic field is not the same as or even related to the material properties of a cryostat. A magnetic field is generated through the flow of electric current and the nuclear spin density refers to the measure of the number of spins within the field per unit volume combined with other constants. On the contrary, material properties refer to the physical characteristics of a component due to the structure or chemical "make-up" of that component.

The Office Action states that Kanayama teaches and shows a main magnet and that without a cryostat the main magnet would not be effective, and further states that the main magnet may be of a permanent, resistive, or superconductive type, and yet further states that a main magnet power source is coupled to a system controller and an eddy current compensation unit. Applicants submit that whether this is true or not is simply irrelevant. The existence of a main magnet and a cryostat, the type of main magnet, and the coupling of a power source to a controller and compensation unit does not imply or suggest the generation of a cryostat material properties signal nor does it imply or suggest the generation of a magnetic stiffness and damping signal or an electromagnetic transfer function in response thereto. Simply put, the reason that Kanayama does not mention a cryostat material properties signal is that component motions and material properties of those components are not of concern in Kanayama, as such they are not mentioned, taught, or suggested. In order to speed up the process of rewriting an event memory one is not concerned with the material properties or motions of components, but rather the generation and manipulation times of signals and data.

The Office Action further states that Kanayama teaches and suggests a mechanical model generator and again refers to the simulator component 24 and the abstract; col.4, lines 1-7; col. 4, lines 27-35; col. 6, lines 31-42; and col. 9, line 57

through col. 11, line 24. As stated above, the simulator component 24 simulates a pulse sequence. The simulator component 24 is not a mechanical model generator and does not generate a mechanical disturbance signal and a mechanical model on a MRI system component in response to component motions and a magnetic stiffness and damping signal. The mechanical model generator of claim 1 and the methods of claims 9 and 19 in generating a mechanical model may generate, for example, a representation of MRI system component geometries, material properties, and boundary conditions. A mechanical model is not taught or suggested in Kanayama. The above-cited sections simply describe the simulation of a pulse sequence, as stated above.

The Office Action further states that Kanayama teaches a structural analyzer and refers to the host computer 12 and CPU 21 of Kanayama for such teaching. The host computer 12 is simply a console at which a user may enter control commands. The CPU 21 is part of the sequence controller, which again simulates a pulse sequence. Kanayama does not teach or suggest a structural analyzer. The host computer 12 and the CPU 21 do not generate a motion signal corresponding to motions of an MRI system component, as does the structural analyzer of claim 1 and the methods of claims 9 and 19.

The Office Action further states that Kanayama teaches a field instability calculator and refers to the gradient power source 4 for such teaching. The gradient power source 4 is used by the system of Kanayama to regulate power received by the gradient coil, which is unrelated to the generation of a field instability signal. The gradient power source, as stated above, adjusts power to the gradient coil in response to eddy current generated. The gradient power source does not generate a field instability signal in response to simulated motions of MRI components. Nowhere in Kanayama is field instability, an electromagnetic transfer function as defined by the present invention, or a motion signal generated in response to the motion of a component mentioned, taught, or suggested.

Moreover, since Kanayama does not teach or suggest any of the limitations of claims 1 and 9 Kanayama also does not teach or suggest the additional limitations

provided in claim 19. Since Kanayama fails to teach or suggest a field instability signal, a motion signal, and an electromagnetic transfer function as defined by the present invention, Kanayama also fails to teach or suggest the frequency sweeping of the field instability signal in response to the electromagnetic transfer function and the motion signal and the modifying of a MRI system component to adjust the field instability signal.

Applicants submit that the arguments provided in the Response of January 9, 2004 against Kinanen remain and are still valid. Thus, Kanayama, as with Kinanen, fails to teach or suggest any of the limitations recited in claim 1, 9, and 19. Claims 1, 9, and 19 are therefore novel, nonobvious, and are in a condition for allowance in view of both Kanayama and Kinanen. Also, since claims 2-8, 10-18, and 20 depend from claims 1, 9, and 19, respectfully, claims 2-8, 10-18, and 20 are also novel, nonobvious, and are in a condition for allowance for at least the same reasons.

In light of the remarks, Applicants submit that all objections and rejections are now overcome. The application is now in condition for allowance and expeditious notice thereof is earnestly solicited. Should the Examiner have any questions or comments, she is respectfully requested to call the undersigned attorney.

The Commissioner is hereby authorized to charge any fees related to this Office Action response or credit any overpayments to Deposit Account No. 50-0476.

Respectfully submitted,

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